Building Infrastructure for Data-Driven Research

Dr. Philipp Zumstein
Mannheim University Library

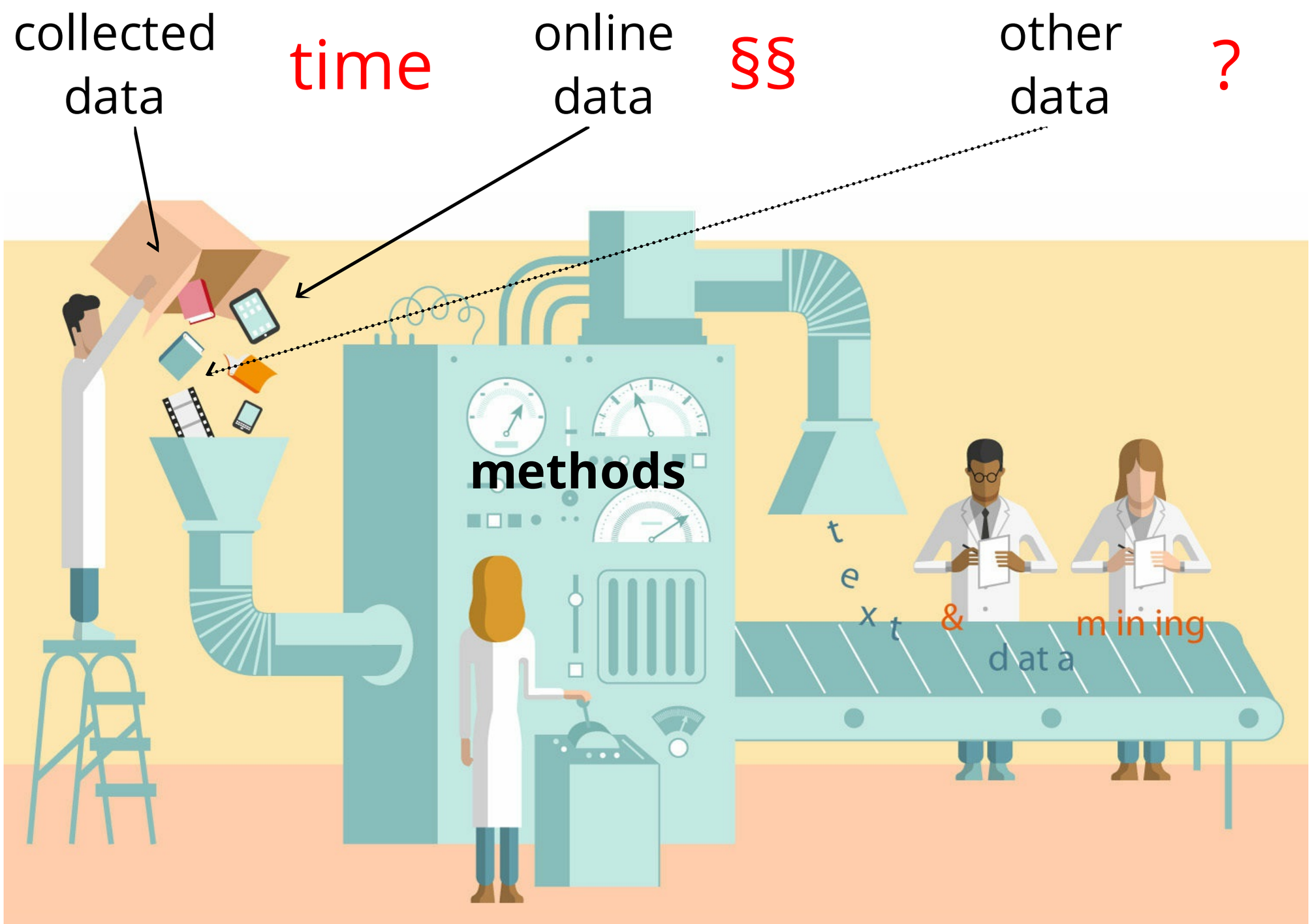
2017-03-15 Social Science Data Lab, Mannheim

https://github.com/SocialScienceDataLab/building-infrastructure-for-data-driven-research

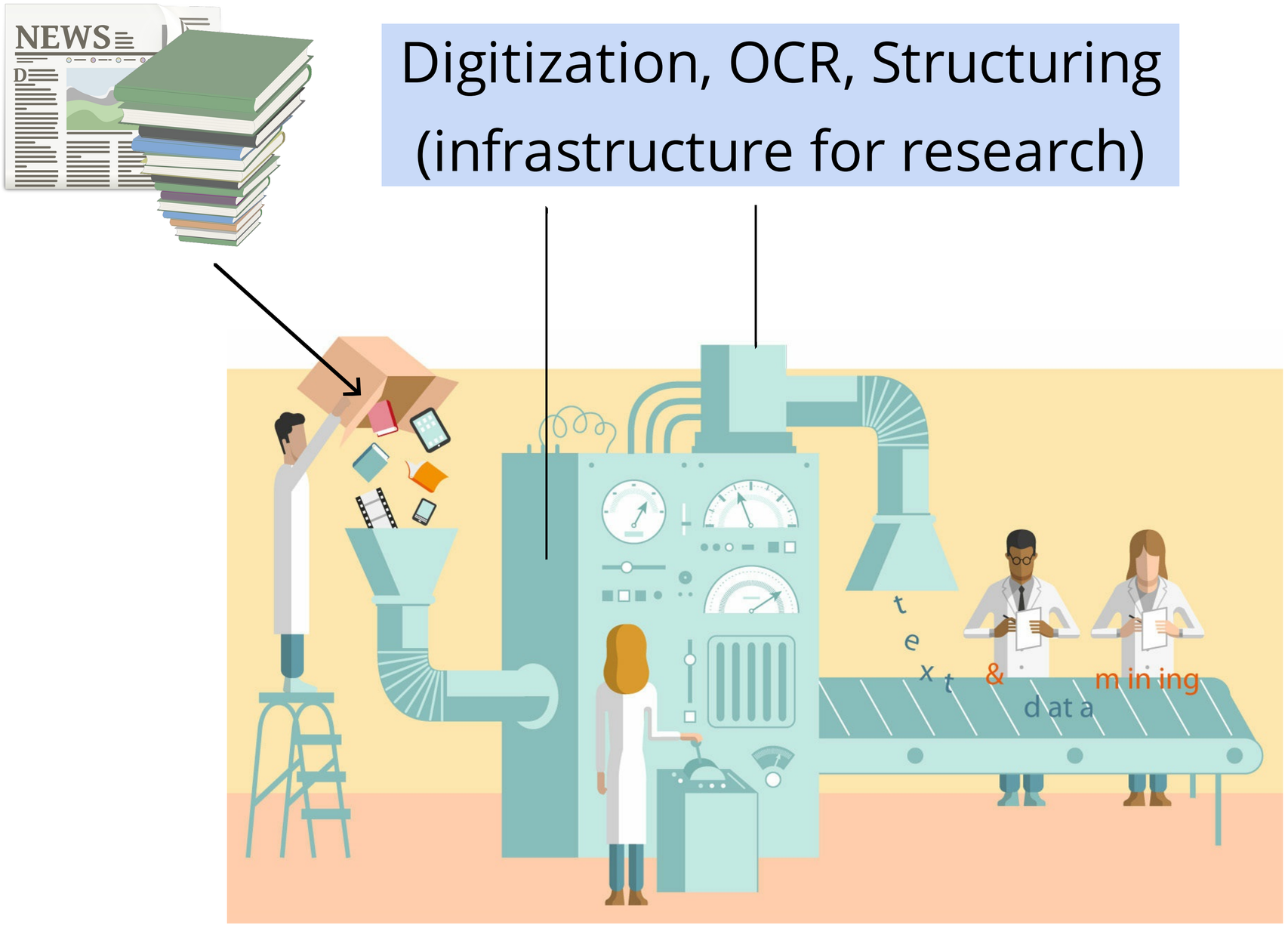
Overview

- Data-driven Research
- Building Infrastructure
- OCR Workflow
- OCR Software
- Applications

Data-driven Research

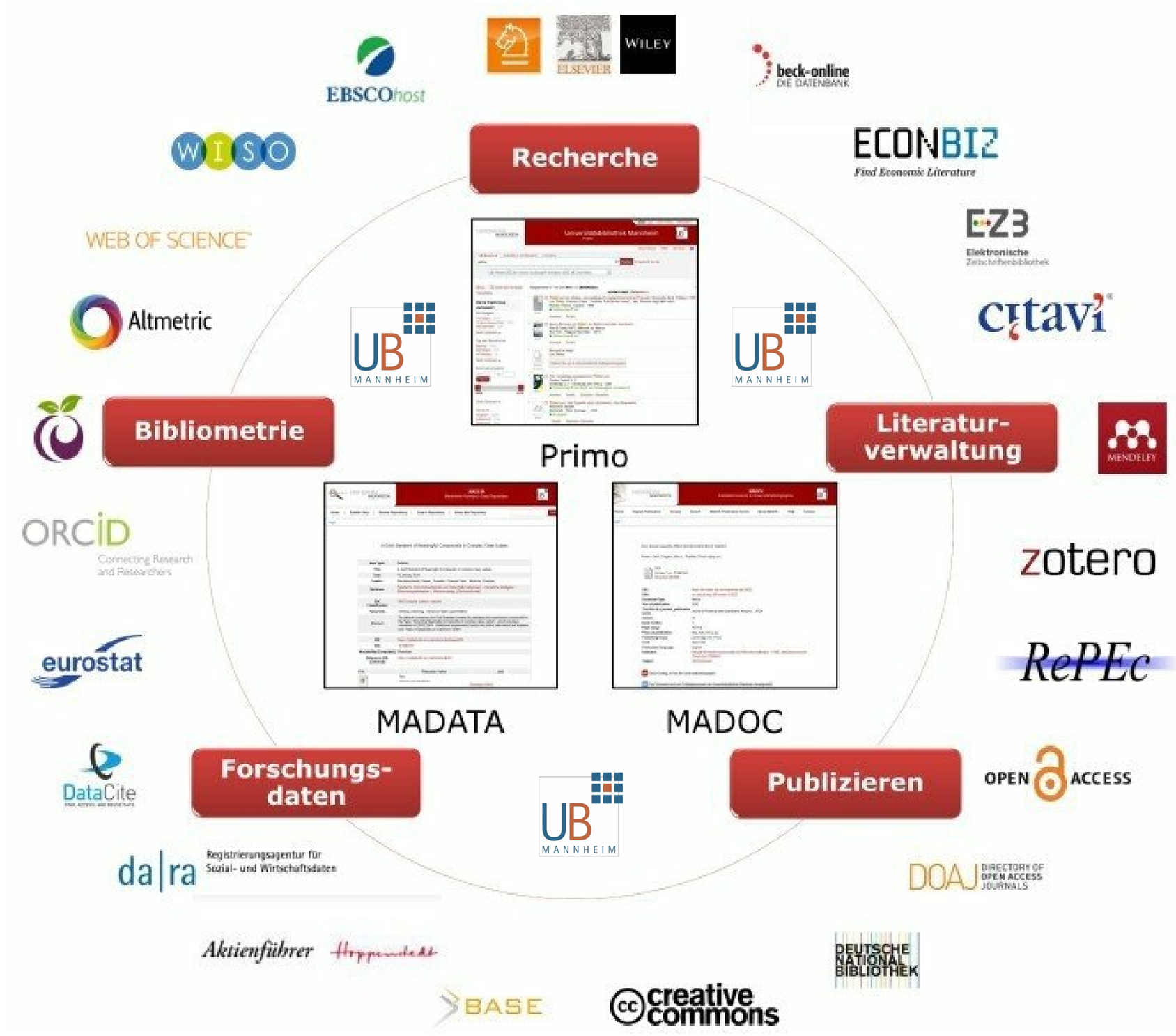


What do you do with images containing text or printed books/newspapers as input?



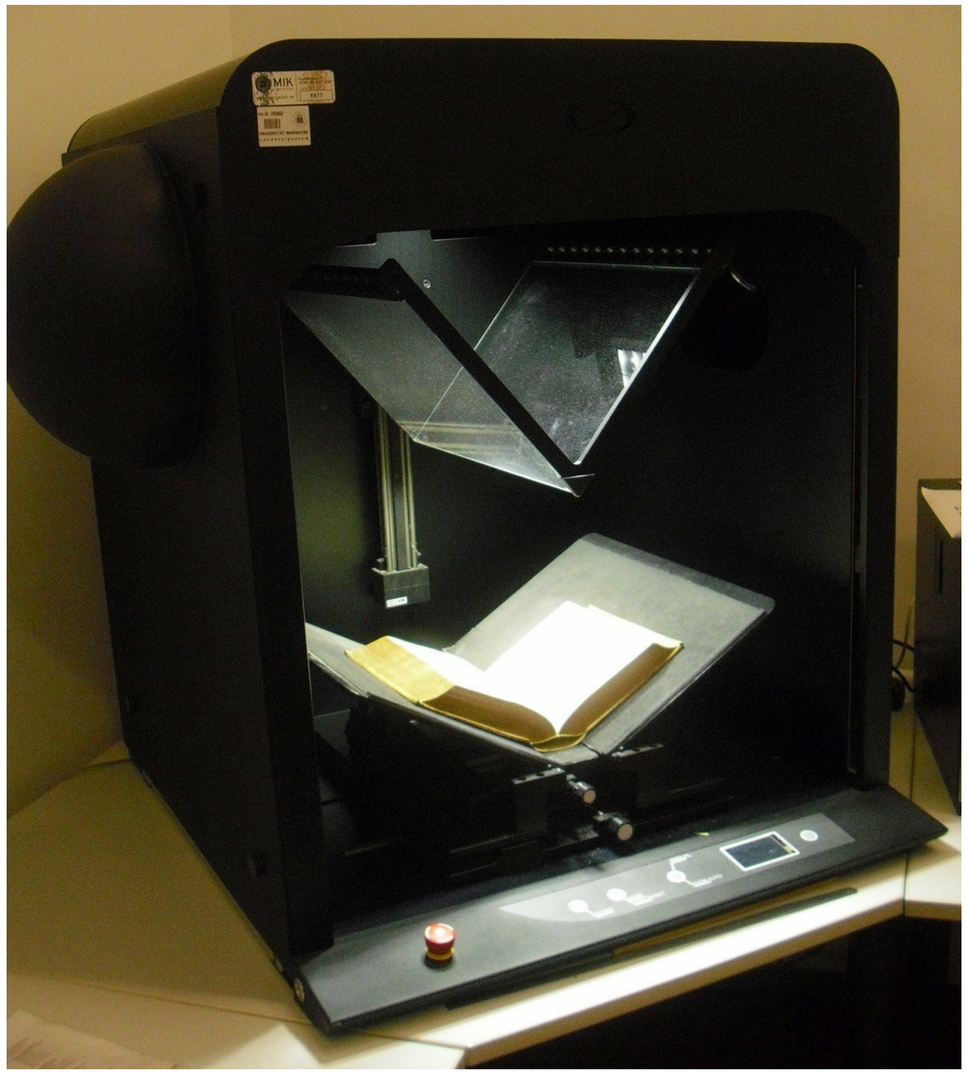
Building Infrastructure

Science Support from Library



Infrastructure for Scanning

A1-Scanner for newspapers etc.



V-Scanner for rare, old, fragile books

Digitization, "Data-ization"

Our Digitization Infrastructure:

- V-scanner
- A1-scanner
- A2-scanner
- A3-scanner
- conservation checks and fixes

Our Expertise:

- scanning workflow
- (manual) double-key-methods
- automatic text recognition (OCR)
- digitizing microfiche, microfilm
- extracting information from CDs to a database
- structuring information
- metadata formats

Infrastructure Projects

Ancien Droit: digitizing 800 books from the 17th/18th century from the collection of Desbillon with focus on the history of the "Ancien Droit" https://digi.bib.uni-mannheim.de/

Aktienführer I+II: digitizing the annualy published books "Aktienführer", extracting the data in a data base https://digi.bib.uni-mannheim.de/aktienfuehrer/

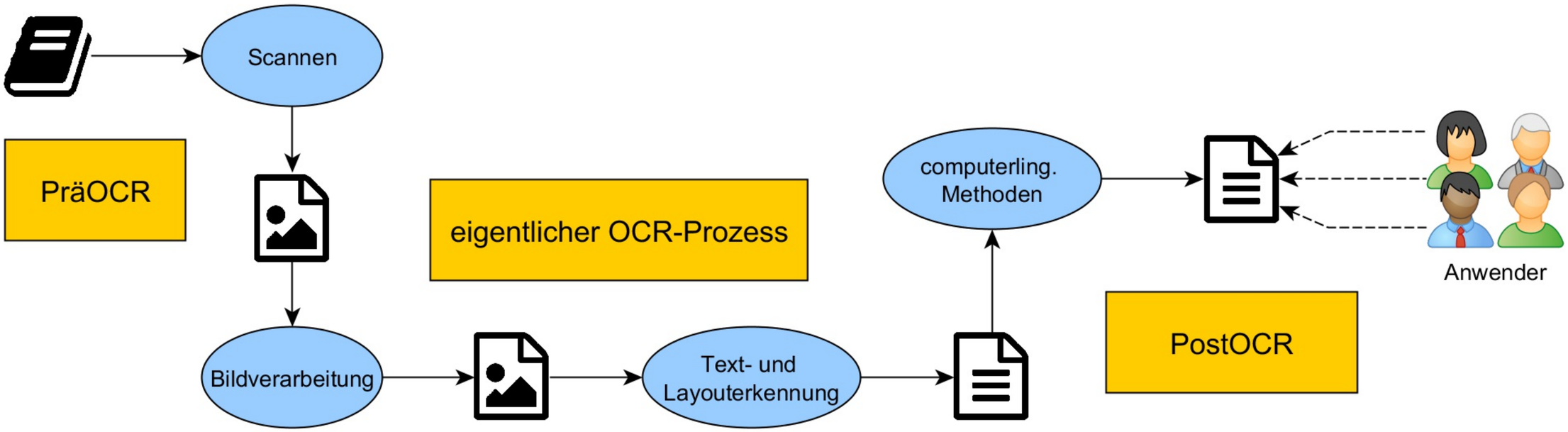
Reichsanzeiger: German newspaper (government gazette) from 1819 to 1945 https://digi.bib.uni-mannheim.de/periodika/reichsanzeiger/

LOC-DB: open, distributed infrastructure for cataloguing of citations https://locdb.bib.uni-mannheim.de/

Infolis I+II: connect research data and publications, text mining scientific articles, integration into different retrieval systems http://infolis.github.io/

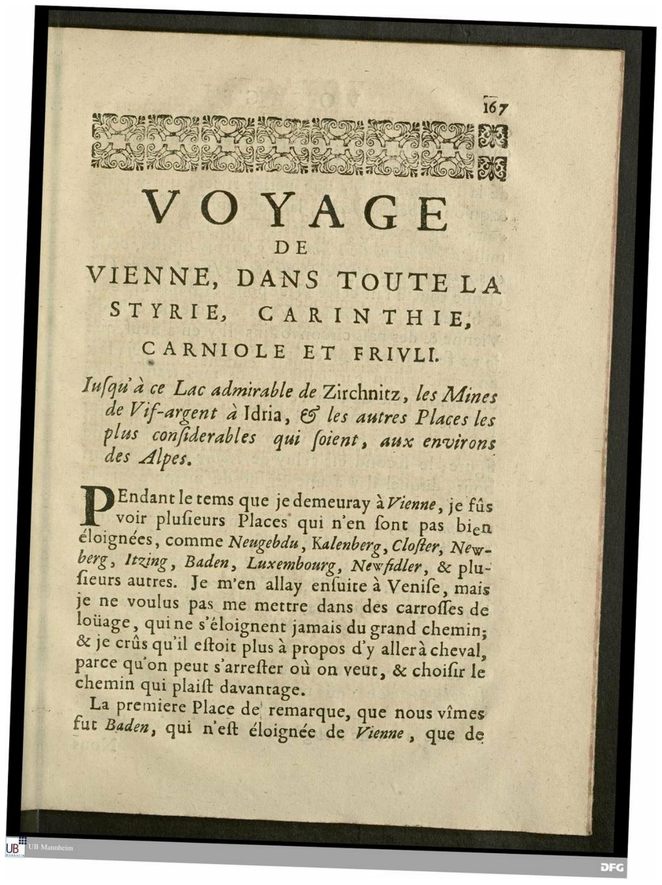
OCR Workflow

Workflow of OCR-Process

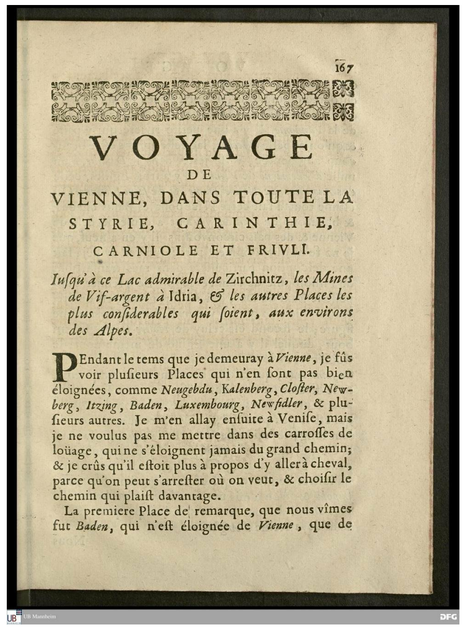


Baierer, Konstantin; Zumstein, Philipp (2016). Verbesserung der OCR in digitalen Sammlungen von Bibliotheken. *027.7 Zeitschrift für Bibliothekskultur / Journal for Library Culture*, v. 4, n. 2, p. 72-83. https://doi.org/10.12685/027.7-4-2-155

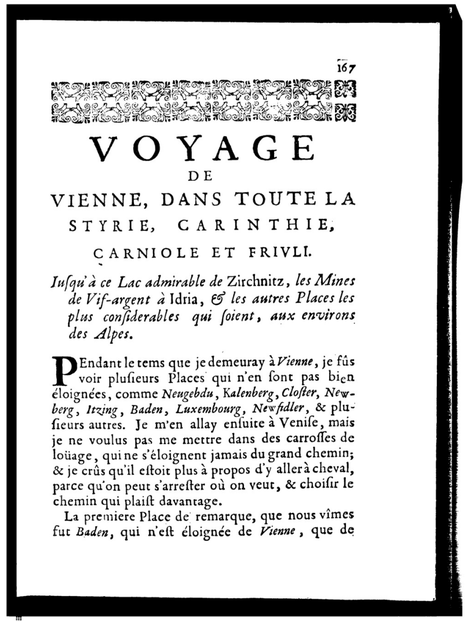
Image Processing

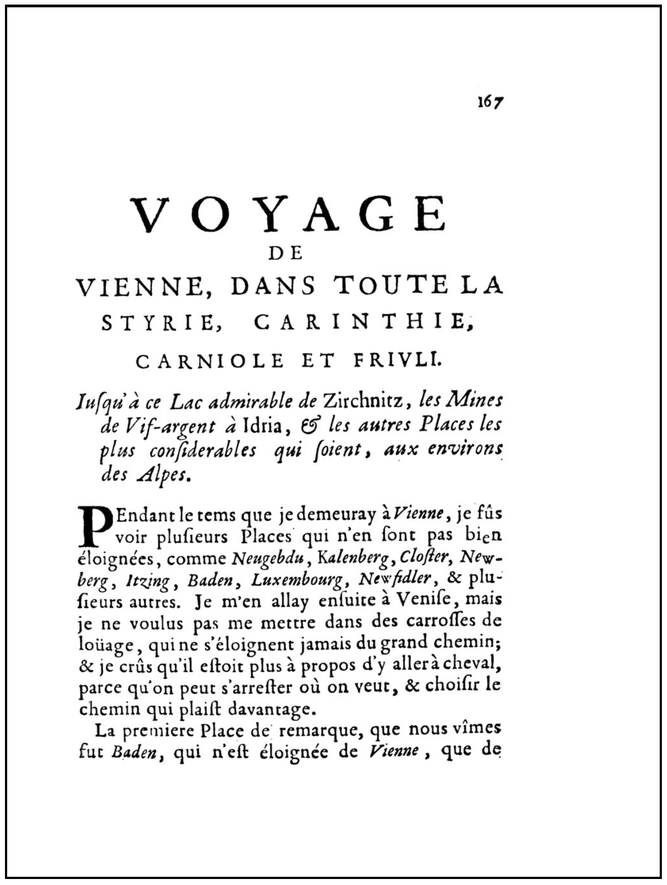


deskew
dewarp



binarize





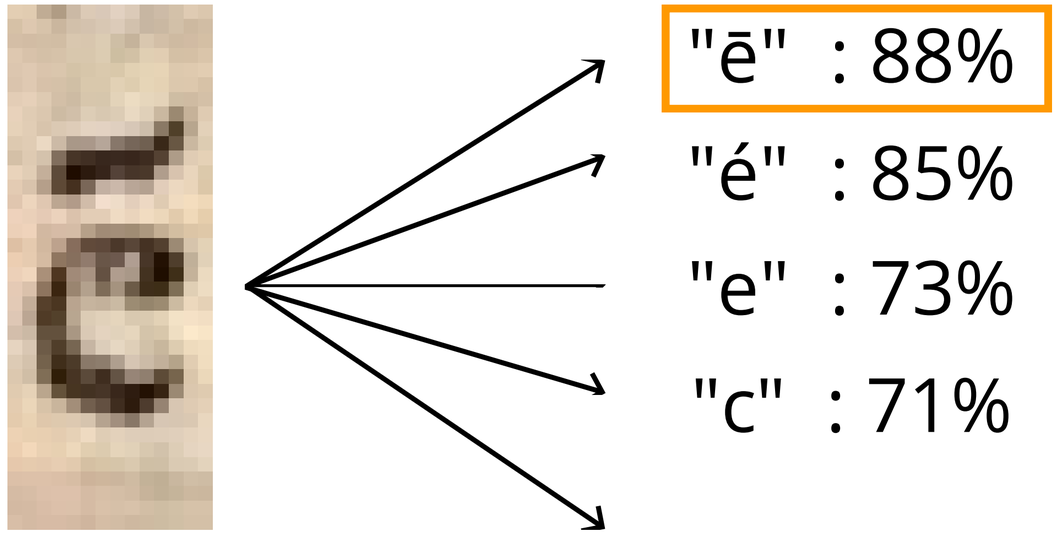
denoise
despeckling

Layout Analysis

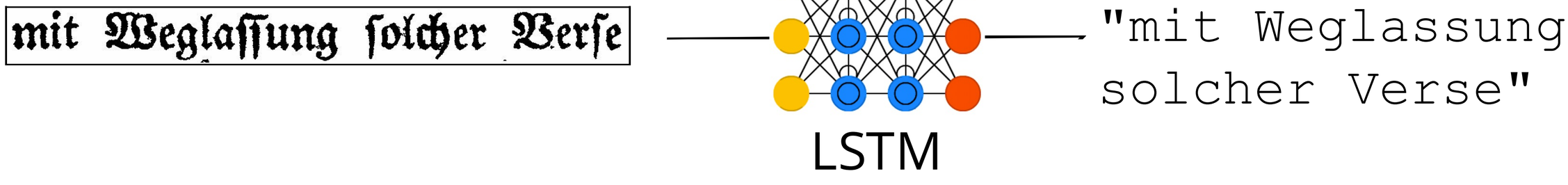
- text vs. image classification
- header, footer, headings
- multi-columns, reading order
- line recognition

Text Recognition

a) character-based recognition



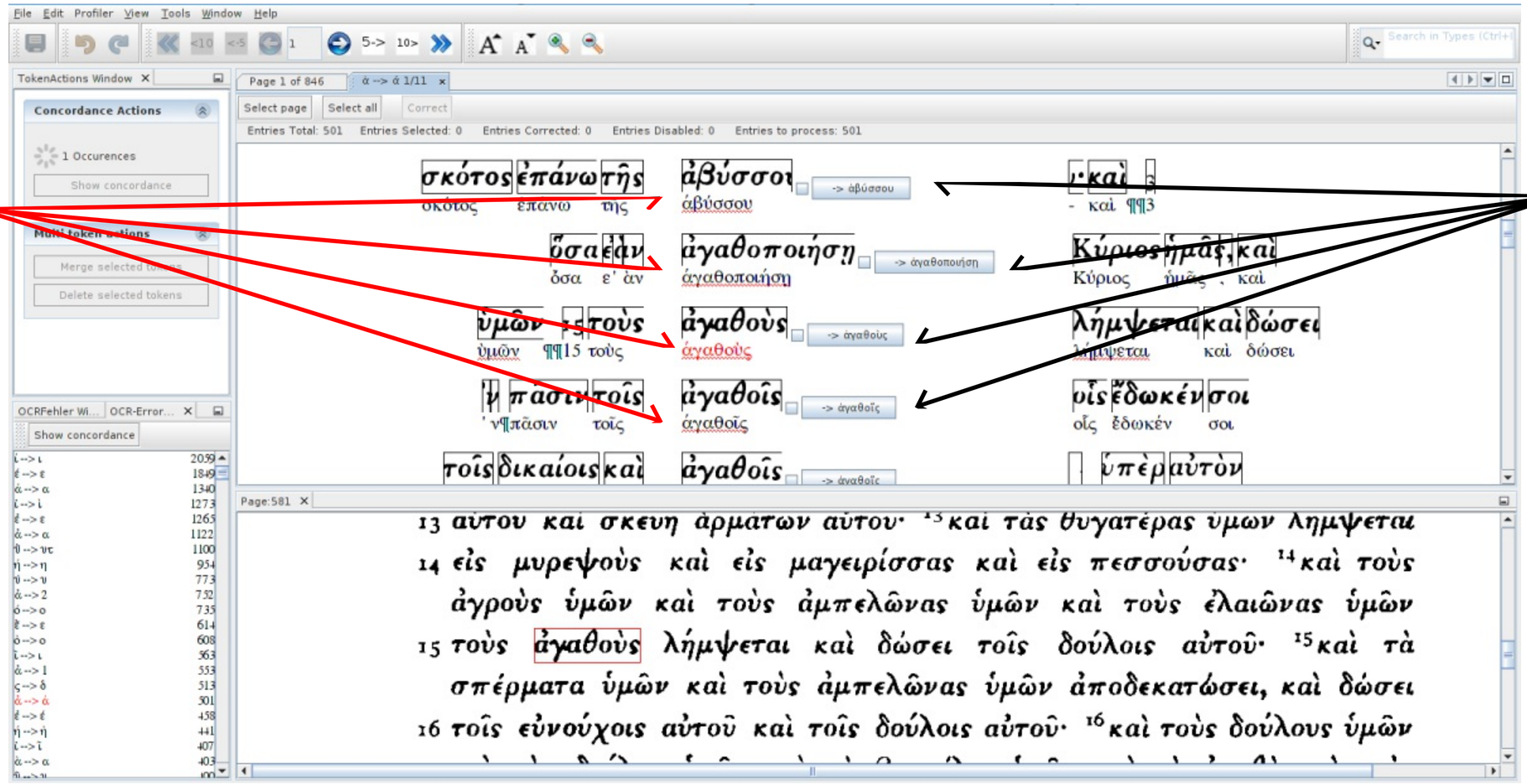
b) line-based recognition



Computerlinguistical Methods

- dictionary
- bigram, -trigrams, etc. for letters and words

non-words = possible errors



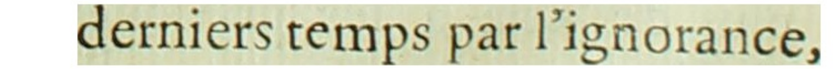
words from the dictionary = possible corrections

Screenshot from PoCoTo used as CC-BY-SA published in:

CIS München (2016): Abschlussbericht zum Projekt "Ausbau und Erweiterung eines Open-Source-Tools zur Nachkorrektur historischer OCR-erfasster Texte" der CLARIN-D Facharbeitsgruppe 4-3 “Klassische Philologie”

Recognition Errors

- OCR results have errors
- errors can occur in each step
  - scanning errors
  - segmentatation/layout errors
  - recognition errors
  - errors in dictionaries
  - untrained characters



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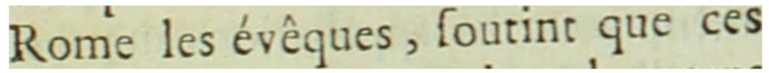

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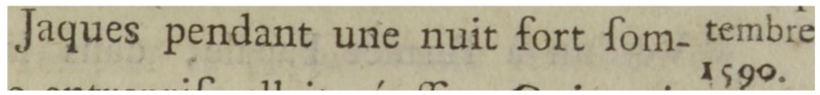
Rome les eveques , loutint que ces



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Jaques pendant une nuit fort fom— It'îîgnïœ

& ſecunda lectu. num. 2. & ſeq. cum nu. 10.

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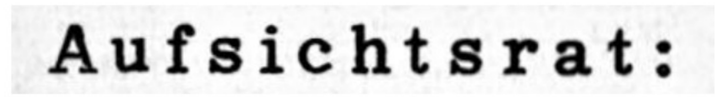
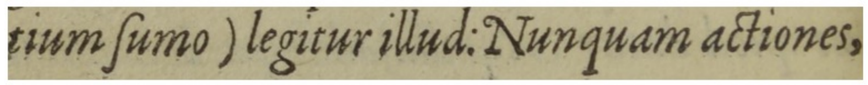


Aufsichtsrat:

A_u_fs_i_c_h_t_s_r_at:



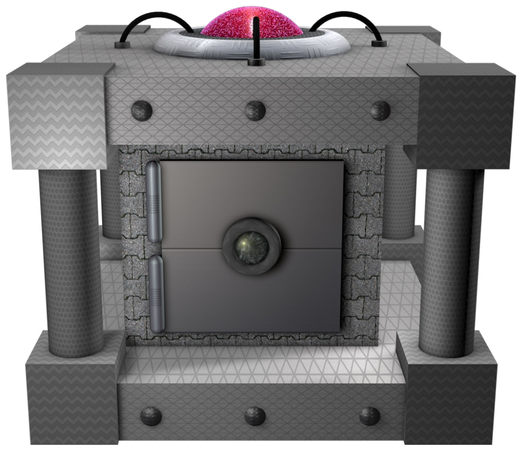
tium ſumo) legitur illud: Nunquam actiones,

tiumsumo)legiturillud:Nunquamactiones,

Advise: Judge the errors with regard to your application (fuzzy search, topic modeling, extracting exact numbers)

OCR-Software

Commercial OCR Software



ABBYY Finereader

e.g. FineReader Engine 11 CLI for Linux (on one server/pc): 120'000 pages / year for 999 EUR

Open Source OCR Software

Tesseract

- started 1985 by HP Labs
- since 2006 Open Source
- supported by Google

Ocropus

- started 2007
- founded and maintained by Prof. Breuel (DFKI, Google, Nvidia)

etc.

ABBYY Finereader

- Normally good results
- Closed source, limited options to change behaviour
- Strong emphazise on language-dependent dictionaries

```
abbyyocr11 -rl German \
        -if input.jpg \
        -f PDF -of output.pdf
```

Tesseract

- Until 2016 character-based text recognition only, now also neural-network-based text recognition
- Less emphazise on language-dependent dictionaries
- github.com/tesseract-ocr/tesseract , part of linux distrib.
- For Windows: github.com/UB-Mannheim/tesseract/wiki
- For R: github.com/ropensci/tesseract

```
tesseract input.jpg output \
        -l eng+deu \
        --oem 1 --psm 7 \
        hocr
```

OCRopus

- neural network algorithm since 2013
- training is key feature
- different models for scripts (not languages)
- no dictionary
- modular scripts (Unix philosophy)

```
./ocropus-nlbin tests/ersch.png

./ocropus-gpageseg ersch/*.bin.png

./ocropus-rpred ersch/*/*.bin.png \
        -m models/fraktur.pyrnn.gz

./ocropus-hocr ersch/*.bin.png
```

OCR Fileformats

- recognized text
- position of the words, lines, characters (bounding boxes)
- confidence values
- text direction, recognized language, formats, ...

e.g. hocr file:

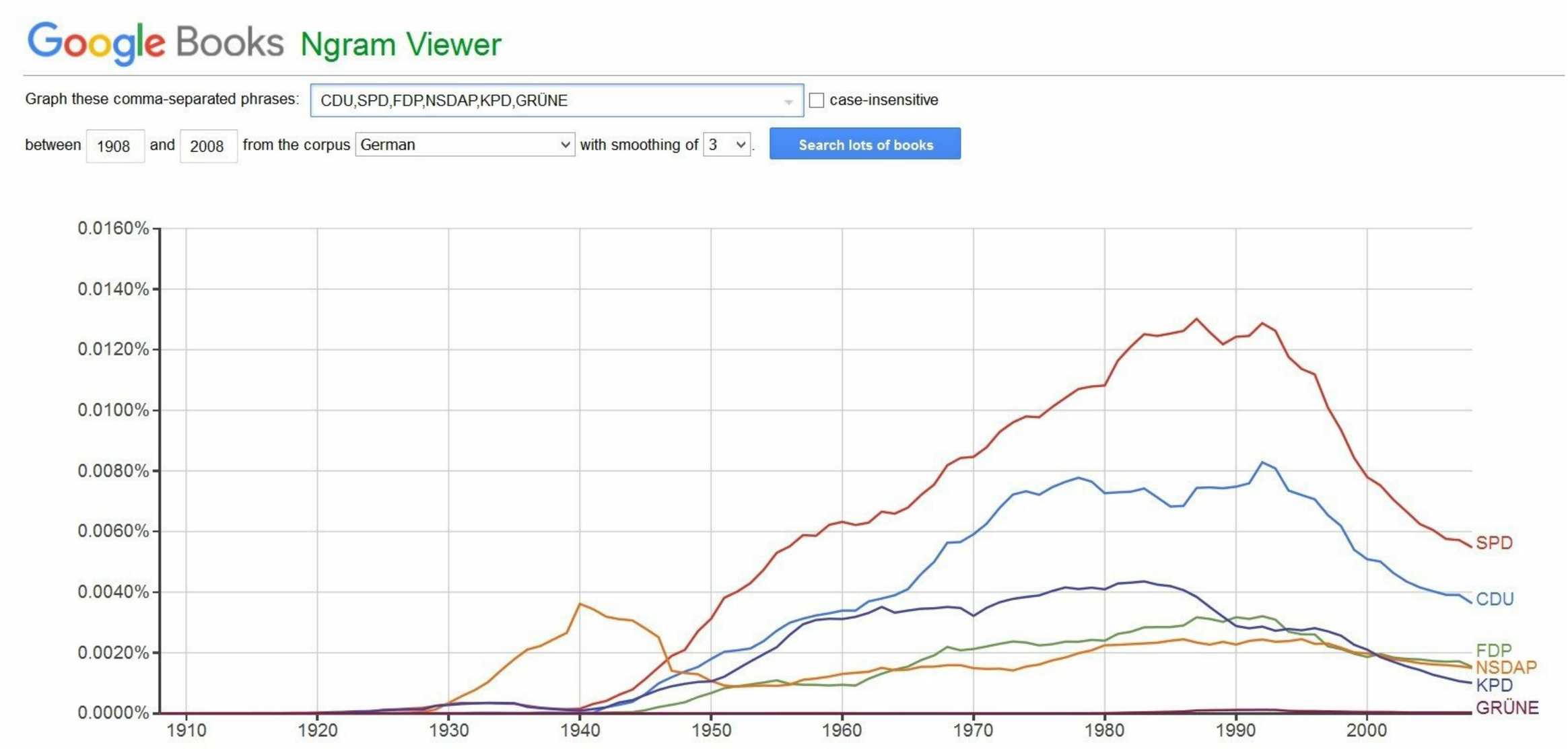
```
<p class='ocr_par' lang='deu' title="bbox930">
...
  <span class='ocr_line' title="bbox 348 797 1482 838; baseline -0.009 -6">
        <span class='ocrx_word' title='bbox 348 805 402 832; x_wconf 93'>Die</span>
        <span class='ocrx_word' title='bbox 421 804 697 832; x_wconf 90'>Darlehenssumme</span>
        <span class='ocrx_word' title='bbox 717 803 755 831; x_wconf 96'>ist</span>
        <span class='ocrx_word' title='bbox 773 803 802 831; x_wconf 96'>in</span>
        <span class='ocrx_word' title='bbox 821 803 917 830; x_wconf 96'>ihrem</span>
        <span class='ocrx_word' title='bbox 935 799 1180 838; x_wconf 95'>ursprünglichen</span>
        <span class='ocrx_word' title='bbox 1199 797 1343 832; x_wconf 95'>Umfange</span>
        <span class='ocrx_word' title='bbox 1362 805 1399 823; x_wconf 95'>zu</span>
        <span class='ocrx_word' title='bbox 1417 x_wconf 96'>ver-</span>
  </span>
  ...
```

Other OCR-formats: ALTO, Page XML, ABBYY XML, TEI, GCV

https://github.com/UB-Mannheim/ocr-fileformat

Applications

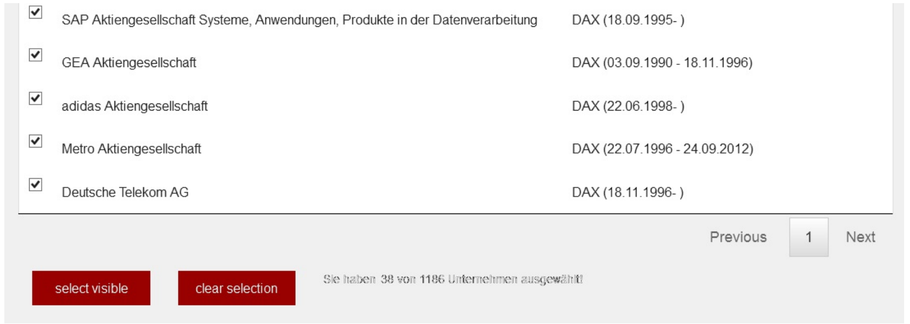
Ngram Viewer (Google Books)

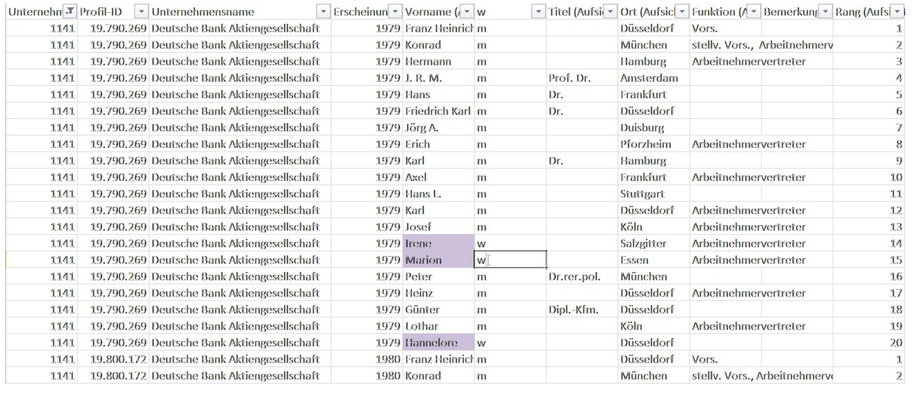


-> View this query online

Number of Females in the Supervisory Board of DAX-30 companies 1979-1999

1. Go to the "Aktienführer Datenarchiv" and there to "Export"
2. Increase number of results to 50, search for "DAX", click on select all visible (38 results)
3. Adjust the year range
4. Select the category "Supervisory Board"
5. Export the CSV data
6. Open in Excel, mark the female names
7. Finally make a pivot table





Unternehm	Profil-ID	Unternehmensname	Erscheinun	Vorname (	w	Titel (Aufsi	Ort (Aufsic	Funktion (A	Bemerkun	Rang (Aufs
1141	19.790.269	Deutsche Bank Aktiengesellschaft	1979	Franz Heinrich	m		Düsseldorf	Vors.		1
1141	19.790.269	Deutsche Bank Aktiengesellschaft	1979	Konrad	m		München	stellv. Vors.,	Arbeitnehmerv	2
1141	19.790.269	Deutsche Bank Aktiengesellschaft	1979	Hermann	m		Hamburg	Arbeitnehmervertreter		3
1141	19.790.269	Deutsche Bank Aktiengesellschaft	1979	J. R. M.	m	Prof. Dr.	Amsterdam			4
1141	19.790.269	Deutsche Bank Aktiengesellschaft	1979	Hans	m	Dr.	Frankfurt			5
1141	19.790.269	Deutsche Bank Aktiengesellschaft	1979	Friedrich Karl	m	Dr.	Düsseldorf			6
1141	19.790.269	Deutsche Bank Aktiengesellschaft	1979	Jörg A.	m		Duisburg			7
1141	19.790.269	Deutsche Bank Aktiengesellschaft	1979	Erich	m		Pforzheim	Arbeitnehmervertreter		8
1141	19.790.269	Deutsche Bank Aktiengesellschaft	1979	Karl	m	Dr.	Hamburg			9
1141	19.790.269	Deutsche Bank Aktiengesellschaft	1979	Axel	m		Frankfurt	Arbeitnehmervertreter		10
1141	19.790.269	Deutsche Bank Aktiengesellschaft	1979	Hans L.	m		Stuttgart			11
1141	19.790.269	Deutsche Bank Aktiengesellschaft	1979	Karl	m		Düsseldorf	Arbeitnehmervertreter		12
1141	19.790.269	Deutsche Bank Aktiengesellschaft	1979	Josef	m		Köln	Arbeitnehmervertreter		13
1141	19.790.269	Deutsche Bank Aktiengesellschaft	1979	Irene	w		Salzgitter	Arbeitnehmervertreter		14
1141	19.790.269	Deutsche Bank Aktiengesellschaft	1979	Marion	w		Essen	Arbeitnehmervertreter		15
1141	19.790.269	Deutsche Bank Aktiengesellschaft	1979	Peter	m	Dr.rer.pol.	München			16
1141	19.790.269	Deutsche Bank Aktiengesellschaft	1979	Heinz	m		Düsseldorf	Arbeitnehmervertreter		17
1141	19.790.269	Deutsche Bank Aktiengesellschaft	1979	Günter	m	Dipl.-Kfm.	Düsseldorf			18
1141	19.790.269	Deutsche Bank Aktiengesellschaft	1979	Lothar	m		Köln	Arbeitnehmervertreter		19
1141	19.790.269	Deutsche Bank Aktiengesellschaft	1979	Hannelore	w		Düsseldorf			20
1141	19.800.172	Deutsche Bank Aktiengesellschaft	1980	Franz Heinrich	m		Düsseldorf	Vors.		1
1141	19.800.172	Deutsche Bank Aktiengesellschaft	1980	Konrad	m		München	stellv. Vors.,	Arbeitnehmerv	2

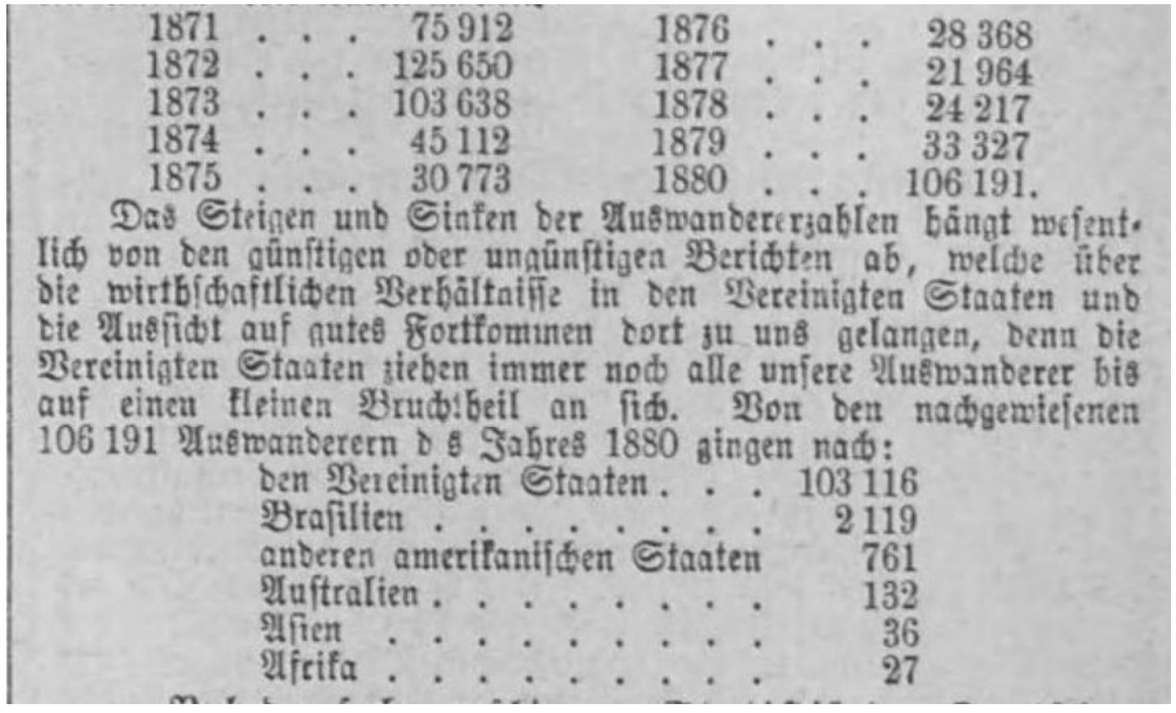
Number and age of German voters for EU vote 1989

1. Go to digizeitschriften.de and then to the Statistisches Jahrbuch für die Bundesrepublik Deutschland 1990
2. Download the pdf of the chapter "Wahlen" starting from page 76
3. Open the pdf in the PDF X Change Viewer, run OCR and save it (or the alternatives you heard before)
4. Download **Tabula** http://tabula.technology/, install it and run it
5. Open pdf in Tabula, select table and extract data as csv

(*) The quality is here not yet optimal, but it shows the possibilities of the tools and data around OCR.

Number of German Emmigrants from 1870 until 1880

1. Go to the Reichsanzeiger
2. Search for "Auswanderer"
3. Be lucky
4. Go to the result

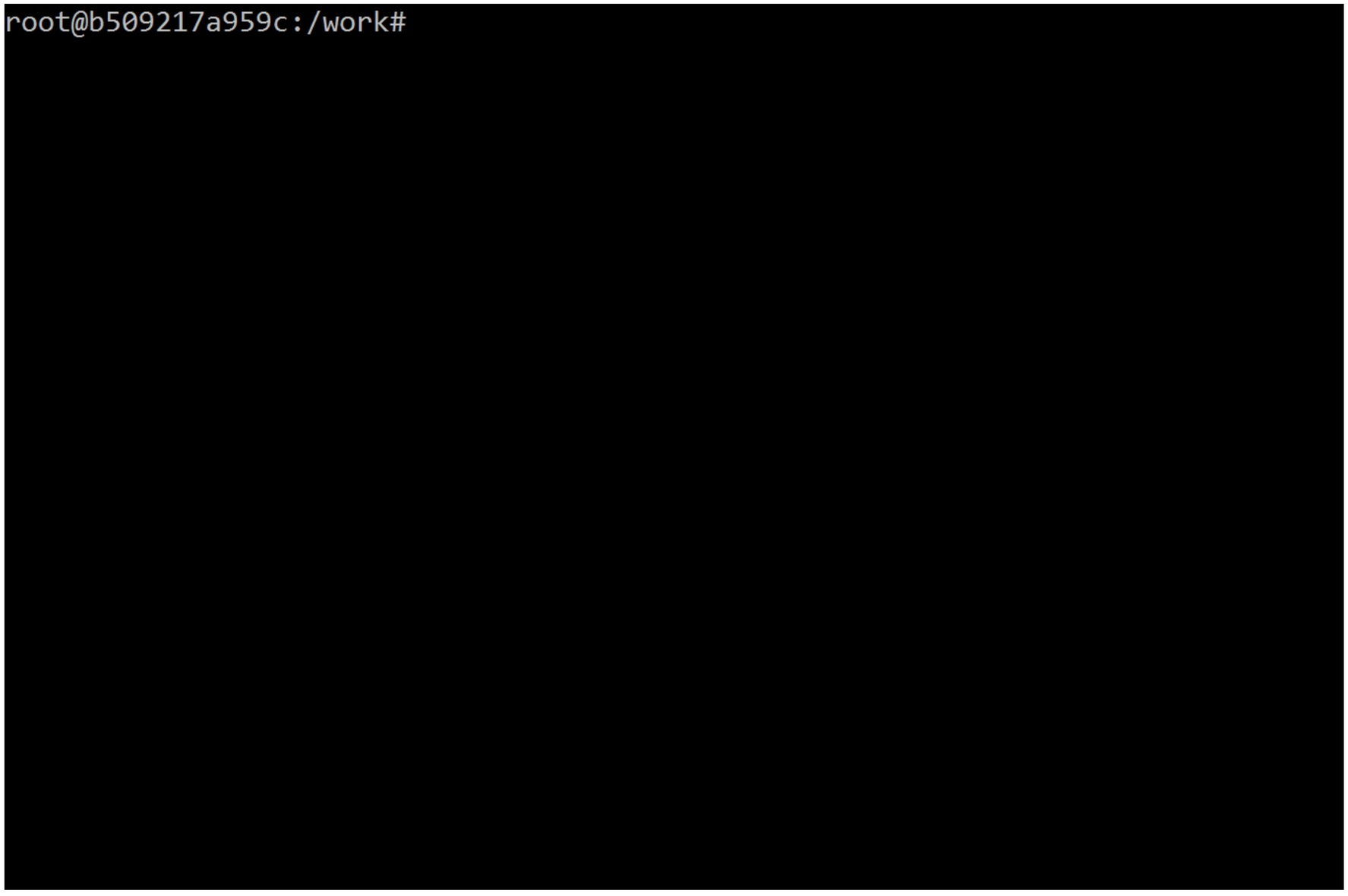


1871 . . .	75 912	1876 . . .	28 368
1872 . . .	125 650	1877 . . .	21 964
1873 . . .	103 638	1878 . . .	24 217
1874 . . .	45 112	1879 . . .	33 327
1875 . . .	30 773	1880 . . .	106 191.

Das Steigen und Sinken der Auswandererzahlen hängt wesentlich von den günstigen oder ungünstigen Berichten ab, welche über die wirthschaftlichen Verhältnisse in den Vereinigten Staaten und die Aussicht auf gutes Fortkommen dort zu uns gelangen, denn die Vereinigten Staaten ziehen immer noch alle unsere Auswanderer bis auf einen kleinen Bruchtheil an sich. Von den nachgewiesenen 106 191 Auswanderern d s Jahres 1880 gingen nach:

den Vereinigten Staaten . . .	103 116
Brasilien	2 119
anderen amerikanischen Staaten	761
Australien	132
Asien	36
Afrika	27

Discussion, Questions?



OCRopus run-test executes nlbin, gpageseg, rpred

List of Images

- Slide 1: https://pixabay.com/de/hong-kong-stadt-st%C3%A4dtischen-1990268/ (CC0)
- Slide 3.2: Copyright User (2013-06): Text and Data Mining (Original Illustration by Davide Bonazzi) http://copyrightuser.org/topics/text-and-data-mining/ (CC-BY)
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- Slide 5.7: Baierer, Konstantin; Zumstein, Philipp (2016). Verbesserung der OCR in digitalen Sammlungen von Bibliotheken. *027.7 Zeitschrift für Bibliothekskultur / Journal for Library Culture*, v. 4, n. 2, p. 72-83. https://doi.org/10.12685/027.7-4-2-155 (CC-BY)
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